DOCUMENT RESUME

ED 204 144 SE 035 249

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TITLE Computers in the Secondary Mathematics Curriculum.
PUB DATE Jun 81
NOTE 34p.

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Annotated Bibliographies; *Computer Assisted Instruction; Computers; *Computer Science; Curriculum Development; Educational Technology; Glossaries; *Literature Reviews; Mathematics Curriculum; Mathematics Education; Mathematics Instruction; *Microcomputers; Secondary Education; *Secondary School Mathematics
IDENTIFIERS *Computer Literacy

ABSTRACT

The purpose of this document is to increase the educator's awareness of the present situation in computers in the school. Although the study was directed at computers in the secondary mathematics curriculum, of necessity much of the material dealt with broader aspects of the computer in all secondary curricula. The first section of this report consists of a glossary of commonly used computer-oriented terms. The bulk of the document is a series of annotations of some of the current literature on computers, the first portion focusing on facts, figures, positions, and attitudes regarding computer use in the secondary curriculum. The second set of annotations deals with computer uses in the mathematics classroom, and is subdivided into the following areas of concentration: (1) the teaching of computer literacy; (2) the teaching of computer science; and (3) computer-assisted instruction. The final annotation section focuses on the special aspects of microcomputers. The document concludes with a summary, some general conclusions, and two specific recommendations regarding computer use at the secondary level. (MP)

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COMPUTERS IN THE SECONDARY MATHEMATICS CURRICULUM

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Submitted in partial fulfillment of the
requirements of the course S591
Indiana University
South Bend
June, 1981

SE 035 249

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INTRODUCTION

"Even after a 20-year period in phenomenal innovations in computer technology and computer applications in mathematics and other school subjects, the long-awaited computer-in-education revolution has not yet arrived." (Bell$_3$:164) Computers in the classroom have been met with grandiose claims and dire warnings but no real understanding. Providing computer literacy, like any education, should be a function of the education system. Yet many educators still lack a clear understanding of the potential and limits of the computer in the school.

The purpose of this study was to increase educator's awareness of the present situation, the potentials and limits of computers in the secondary mathematics curriculum. It was hoped that increasing their awareness would lead to increased applications of computers in the classroom.

Although this study was directed at computers in the secondary mathematics curriculum, of necessity much of the material dealt with the broader aspects of the computer in all secondary curriculums. This study was limited to the instructional uses of the computer. None of the aspects of the computer as an administrative tool were included, although it should not be assumed that the computer does not have value in this area.

The first section of the study dealt with the present, or recent past, situation of computers in the secondary schools

-- the percentage of schools using computers for different purposes and the attitudes of educators and organizations toward what was happening and what should happen in the schools with respect to computers.

The second section dealt with the uses of computers in the mathematics classroom. This section was divided into what was believed to be the three major applications, or areas of concentration, of computers in the mathematics curriculum; the teaching of computer literacy, the teaching of computer science, and computer-assisted instruction. Each of these three subsections included the perceived advantages and disadvantages of using computers for that purpose, information obained mainly from opinions of educators, and the actual effects of computer literacy, computer science and computer-assisted instruction programs, respectively, information obtained from research studies and reports of programs from involved educators.

Lastly, this study included a subsection which dealt with the special aspects of microcomputers. Although microcomputers can be used in any of the above applications, they do have some different advantages and disadvantages which it was felt needed to be included.

DEFINITION OF TERMS

calculator -- "a device that performs primarily arithmetic operations based upon data and instructions inserted manually" (Sippl and Sippl:57)

computer -- "a device with self-contained memory capable of accepting information, processing the information, and outputting the results" (Spencer:15)

computer-assisted instruction (CAI) -- "an educational concept which places the student in a conversational mode with a computer which has a preprogrammed study plan" (Sippl and Sippl:99)

computer-assisted learning (CAL) -- synonymous with CAI

computer-based instruction (CBI) -- synonymous with CAI

computer language -- "a programming procedure or language in which instructions are computer instructions only, the machine language that the computer was designed to understand" (Sippl and Sippl:101-102)

computer literacy -- "the ability to define, demonstrate and/or discuss how computers are used, how they do their work, how they are programmed, how to use a computer and how computers affect our society" (Brumbaugh:49)

computer program -- "a plan or routine or set of instructions for solving a problem on a computer" (Sippl and Sippl: 102)

computer programming -- "the study of designing computer programs" (Sippl and Sippl:102)

Computer Science -- "the field of knowledge that involves the design and use of computer equipment, including software development" (Spencer:17)

data processing -- "rearrangement and refinement of raw data into a form suitable for further use" (Sippl and Sippl: 130)

debug -- "to locate and correct any errors in a computer program" (Sippl and Sippl:135)

hardware -- "the magnetic, mechanical, electrical and electronic devices from which a computer is constructed" (Spencer:27)

microcomputer -- a complete computer reduced in size with limited speed and storage capacities (Folk:608)

personal computer -- synonymous with microcomputer

simulation -- the act of "generating test conditions approximating actual or operational conditions" (Morris:1207)

software -- "the totality of programs and routines used to expend the capabilities of computers" (Spencer:50)

ANNOTATIONS

PRESENT SITUATION OF COMPUTERS IN THE CLASSROOM

Facts and Figures

Bukoski, William J. and Krortkin, Arthur L., "Computing Activities in Secondary Education," Educational Technology, 16:9-22, January, 1976.

The authors reported on the 1975 Project CASE (Computing Activities in Secondary Education) survey and compared the results to their 1970 survey. They found that from 1970 to 1975 computing in secondary education had steadily increased from 34.4% to 58.2%. These percentages represented surveyed school systems which were using a computer for administrative and/or instructional purposes. A trend was found toward using the computer more fully. The percentage of schools using computers for both purposes was up 11.3%, while the percentage of schools using computers for one purpose only dropped 8.4%. The two most frequently used instructional applications were for problem solving and for computer science courses. However, the use of the computer for CAI, gaming and simulation each rose over 5%.

Chambers, Jack A. and Bork, Alfred, "Computer Assisted Learning in U. S. Secondary/Elementary Schools," The Computing Teacher, 8(1):50-51, Academic Year 1980-81.

This article was a summary of a 1980 study undertaken by the Task Force on Computer Assisted Learning. They found that 90% of the school districts surveyed were using a computer for instructional and/or administrative purposes. Instructional usage rose from 13% in 1970 to 74% in 1980 and it was anticipated to reach 87% by 1985. Fifty percent of the school districts were using the computers for CAL, the largest usage being in the mathematics department. School systems that were using computers found the major impediments to their more successful use to be finances, lack of knowledge and attitudes.

Computers in Public Education Study, Educational Resources Information Center, ED 179 193, National Institute of Education, Washington, D. C., August 3, 1979, 39 pp.

This study was a survey of the use of computers in U. S. public schools based on questionnaires and corroborated with data from computer system manufacturers. They found that 78% of all schools were using computers for administrative and/or instructional purposes. Twenty-eight percent of the schools surveyed were offering elective instruction in Computer Programming/Data Processing and almost six percent were using them to some degree for CAI. The most frequent applications found were for teaching mathematics and for teaching computer science, itself. The survey indicated a dramatic positive shift in attitude toward computer involvement in the past nine years. They also found an increasing shift toward micro-computing systems.

Positions and Attitudes

"Computers in the Mathematics Classroom," Mathematics Teacher, 71:468, May, 1978.

This was a position statement regarding computers in the mathematics classroom prepared by the Instructional Affairs Committee and approved by the Board of Directors of the NCTM (National Council of Teachers of Mathematics). Their stated position was that "computers should be made readily available as an integral part of the education program." According to the NCTM, every student should have first hand experience with the capabilities and limitations of computers. And although the study of computers, themselves, is valuable there should also be an awareness of the advantages of computers in problem solving and as an instructional aid.

Fey, James T., "Mathematics Teaching Today: Perspectives from Three National Surveys," Mathematics Teacher, 72:490-504, October, 1979.

The author reported on three National Science Foundation commissioned studies of current practices and basic needs in science, mathematics and the social sciences. The third study was a collection of case studies dealing in part with changing school mathematics. The observers noticed many factors inhibiting change, factors helping to keep calculators and computers out of the classroom. Among them was a strong, status quo curriculum established by tradition and upheld by parents, teachers and administrators.

Martellaro, Helena C., "Why Don't They Adopt Us?," Creative Computing, 6:104-105, September, 1980.

This article attempted to answer the question of why computers are trickling into the schools so slowly and what must be done to change this trend. Teachers, according to this author, are of three types: those who believe that computers would dehumanize education and want them kept out, those who believe that they have potential but are frightened of computers in their classrooms, and those who have realized their potential and want to use them now. Martellaro stated that most teachers belong to the second group and need to be positively influenced if computers are to be a major educational tool. Computers would have to be experimented with on a small scale so that their perceived complexity could be overcome and their usefulness become more apparent.

Taylor, Ross, "NACOME: Implications for Teaching K-12," Mathematics Teacher, 69:458-463, October, 1976.

The National Advisory Committee on Mathematics Education Report made several recommendations with respect to calculators and computers. It was recommended that every secondary mathematics student have access to a computer terminal. They concluded that the computer should be integrated into the total curriculum-- used for simulations, modeling, inquiry and other instructional applications.

COMPUTER USES IN THE CLASSROOM

The Teaching of Computer Literacy

Perceived Advantages and Disadvantages

Bell, Frederick H., "Computer Literacy, School Mathematics and Problem Solving Three for the Price of One," AEDS Journal, 12:163-170, Summer, 1979.

This author suggested that there was a crisis in mathematics literacy, computer literacy and problem solving literacy. He further suggested that computers could be the answer to all three problems. He maintained that integrating computer literacy into the mathematics curriculum would not only solve that problem but it would help with problem solving and mathematics literacy since the exposure to some programming would require all of the activities needed for effective problem solving and would practice good mathematics.

Bruchmann, Harold, "Let's Get Our Priorities Straight," The Computing Teacher, 8(3):45-46, Academic Year, 1980-81.

Bruchmann discussed setting priorities in the use of computers in the schools. He stated that there are three areas of concentration; computer science, CAI and computer literacy. He felt that giving priority to the computer science courses would benefit only a small group of students. He projected that CAI would decrease in importance in the forseeable future because of its many inadequacies, for example the lack of quality software. And so he contended that computer literacy should occupy the first position on the list of priorities since, according to him, all post-secondary use of school learned skills would in some way be related to computers.

Dunlap, Mike and others, Computers and Computer Literacy in the Algebra I and Trigonometry Classroom, Educational Resources Information Center, ED 188 861, Oregon Council for Computer Education, Portland, Oregon, September, 1974, 34 pp.

This report stated that "any educational program which strives to prepare the student for his post high school life is incomplete unless it introduces the student to the capabilities, applications and implications of computers." The authors maintained that some students would eventually have careers directly involved with computers, some would have non-computer careers in computer or related fields and others would have careers with passive contacts with computers. But even a person in this last group would find a computer based system to be the link between himself and any large organization with which he would deal, according to the authors. They concluded therefore, that "all students should be computer literate at a level commensurate with their overall level of education."

Knight, Anne H., "Computer Anxiety: One Way to Handle It!," Creative Computing, 5:74-75, September, 1979.

Knight discussed the frustration and anxiety of trying to keep up with a rapidly changing, highly technological society. One symptom of this problem is what she termed'computer anxiety', that is, the fear and uncertainity about dealing with a computer. She stated that educational institutions were fostering this problem by not introducing computers in the early learning stages. Her belief was that students (and parents) should be given a lot of opportunity for hands-on experience combined with non-machine based activities such as group discussions. She felt that these approaches to dealing with computer anxiety should ease the anxiety of trying to keep up with a rapidly changing, highly technological society.

Effects of Computer Literacy Programs

Dahlberg, Henry, Director, "Computer Literacy Project," The Computing Teacher, 7:15-16, June/July, 1980.

This article described and gave the results from the Computer Literacy Project undertaken in Prescott, Arizona. The schools there had offered computer programming courses for five years before the increasing importance of computers prompted them to offer this course to all students grades 4 through 12. Part of the classtime was spent in discussing the social aspects and the impact of computers on employment. And some of the time was devoted to hands-on programming experiences. It was felt that students gained a working knowledge of what computers were all about-- what they are and are not capable of doing and what effects they will have on their futures.

Hicks, Bruce and others, Students: Where the Action Is!, Educational Resources Information Center, ED 138 280, Department of Secondary Eduation- University of Illinois, Urbana, Illinois, August, 1975, 26 pp.

This study described student participation in computer applications through classroom use. Three positive outcomes were given from the program. First, computer literacy gained through specific discussions in classes, readings, student's own experiences with computers and observation of other's work with computers. Secondly, computer language acquisition. Students acquired the ability to ask the computer to solve appropriate problems. And thirdly, they saw a feeling of community arising from the sharing of resources by all students and teachers-- they were not a resource for one elite group.

The Teaching of Computer Science

Perceived Advantages and Disadvantages

Hamblen, John W., The Societal Impact of Computers, Educational Resources Information Center, ED 178 049, University of Missouri-Rolla, Rolla, Missouri, October 4, 1978. 15 pp.

This author addressed himself to the growing need for (and lack of sufficient) computer technologists. He estimated that the demands for computer personnel exceeded the qualified staff by 200%. He gave his belief that the schools must take on the responsibility of educating students to fulfill these needs. According to Hamblen, high schools must become more involved in the teaching of computer science languages. He did not see high school graduates as becoming entry level personnel, rather that they should provide the background for university studies.

Hamming, R. W., "Intellectual Implications of the Computer Revolution," American Mathematical Monthly, 70:4-11, January, 1963.

The thesis of this author's paper was that computers were an intellectual phenomenon of our society as well as a material phenomenon. He stated that computers were capable of doing more than the usual operations only faster and easier. He believed that computers made it possible to pose new types of questions and find new answers. But in order to do that, education is needed. Schools need to teach the new ideas and thought processes made possible by the computer-- need to change the ways in which computers are considered. This was his reasoning for advocating that computer education be taught in the schools.

The Use of the Computer in Teaching Secondary School Subjects, Educational Resources Information Center, ED 146 885, Organization for Economic Co-operation and Development, Paris, France, 1976, 74 pp.

This work was based on the findings of panels of international computer researchers studying the problem of how computers could be used to enhance learning within the secondary curriculum. They concluded that computers should be used to teach tasks that it alone can fulfill or that it can carry out markedly better. For this reason they agreed that the original emphasis on CAI was inappropriate and stressed the value of computer science. They concluded that some sort of computer programming study would be valuable to all students to introduce them to new avenues of thought processing.

Effects of Computer Science Programs

Bell, Frederick, H., "Why is Computer-Related Learning So Successful?," Educational Technology, 14:15-18, December, 1974.

This article summarized findings of several pilot programs to follow the success of computers in the classroom. It was found that students who wrote and executed computer programs to solve mathematical problems performed significantly better on tests constructed to measure concept understanding than did students who did not have access to a computer. There seemed to be no significant effect on skill mastery, however. Reasons given for the success of computers included their novelty, their ability to free students natural motivation and curiosity and the opportunity to be creative and make something work.

McCraig, Duncan A. and Jansson, Lars C., "A School Computer Network," Mathematics Teacher, 71:694-697, November, 1978.

The authors discussed a computer education program begun in 1967 in Manitaoba, Canada. It was directed at 15 through 18 year olds, aimed mostly at those students planning on some sort of higher education. Since the program began, they have found more students carrying their computer education on into university studies and an increase in enrollment in their courses. After the initial year or two, computer interest and use in other disciplines rose as well. So that their computers are being used in simulations and problem solving throughout the school.

Stone, Deborah, "Computers at an Alternative School," Creative Computing, 6:46-47, September, 1980.

Stone, a teacher in a New York private school for students who for one reason or another did not fit into the public school, reported on the effects of computers on her students. First the students played with the games and then some of them began working on programming. Since the faculty knew nothing about computer programming, all work was done by the students alone. They had no guidelines, no set curriculum and so they were free to be innovative, creative and inner-directed. As the author put it, "many kids who don't do well in school are secret computer geniuses because there is nobody telling them what to do."

Saunders, James, "What are the Real Problems Involved in Getting Computers into the High School?," Mathematics Teacher, 71:443-447, May, 1978.

The author, a mathematics teacher at a high school in Pittsbrug, followed his high school's efforts in obtaining and utilizing a computer. Because of the nature of their machine they did not feel that it was suitable for CAI, so students used it during class to solve problems and it was always made available to them for working on programs of interest. The author supported the idea that this computer usage helped students to develop good logical thinking patterns--to plan step-by-step, to anticipate errors and to check solutions. He also concluded that the computer was a powerful tool for helping students learn about mathematics.

Walzl, F. Neil, The Development and Implementation of a District Computer Education Program, Educational Resources Information Center, ED 126 934, Newark School District, Newark, Delaware, November, 1975, 395 pp.

This study reviewed a summer Computer Education Program at a high school in Delaware. Students had their program assignments chosen by the instructors on the basis of their individual mathematics background. So each student was also responsible for determining and learning the necessary mathematics in order to complete the program. The benefits of the program they gave were the opportunity to learn and practice programming skills, the opportunity to learn additional mathematical content and the develoment of skills concerning the use of mathematics textbooks as references. At the conclusion of the course, it was assessed that the students exhibited a knowledge of programming skills which should be of use to them in future years.

Computer Assisted Instruction

Perceived Advantages and Disadvantages

Bell, Frederick H. "Can Computers Really Improve School Mathematics?," Mathematics Teacher, 71:428-433, May, 1978.

Bell stated that during the new-math era another curriculum development was also emerging-- computer-enhanced learning. Some of the uses of computers in the mathematics classroom he gave were to present unfamiliar concepts and principles in conjunction with textbooks, to provide individualized tutoring, to help drill students and help them practice skills, to help students learn algorithms and to give students additional methods of motivation. He stated that educators should "find ways for students to use and control the computer in their classes so that they can become active researchers and discoverers, rather than being passive receivers of knowledge."

Dunn, Alex and others, Computer-Assisted Instruction Program, Educational Resources Information Center, ED 100 361, Montgomery County Public Schools, Rockville, Maryland, 1974, 203 pp.

This author made recommendations based on the Montgomery County Public Schools CAI Program. It was recommended that CAI instructional packages be provided to secondary schools in order to provide greater individualization. These consequences were projected; classes could be increased by 40% and each student would still receive significantly more individual attention, students would acheive as well or better in traditional classes with the use of CAI and underacheiving students would acheive significantly better.

Kahn, Henry F.,"Needed: An Alternative for Mathematics Textbooks," School Science and Mathematics, 79:473-476, October, 1979.

It was suggested that a computer 'problem bank' could be an answer to the problem of individualizing and updating textbooks. There would be a variety of exercises developed at various levels so that all students could be served by calling up appropriate material using descriptors, The author felt that this particular type of CAI would be very useful with students who needed constant and repeated drill. Some limitations given included the limitations of the teachers developing and using the programs and the fact that only exercises involving computational skills and processes would be appropriate.

Joiner, Lee Marvin and others, "Potential and Limits of Computers in Schools," Educational Leadership, 37:498-502, March, 1980.

These authors addressed themselves to the issue of what computers (mainly as CAI) can and cannot do for the educators and students in the schools. Some of the potentials that the authors noted included compressed learning time, individualization, an excellent means of teaching basic skills to reluctant learners and a means of providing instructional equality for students in schools where small enrollments might limit course offerings. Some limits they cited included equal or slightly worse long term retention, a time limit of 20-30 minutes of work on the machines since it is so intense and a need for better software and teacher inservice courses to use the computers to their fullest potentials.

Effects of Computer Assisted Instruction Programs

Effects on Acheivement

Fletcher, J. D. and others, A Note on the Effectiveness of Computer Assisted Instruction, Educational Resources Information Center, ED 071 450, Stanford University, Stanford, California, December 6, 1972, 11 pp.

This report suggested that there are strong and consistent acheivment gains by students when they are given CAI. The authors listed 16 studies from all areas of education that discussed programs in which CAI had been effectively used. More extensive research revealed practically no negative findings in CAI evaluations. Nearly all of the students revealed a significantly better performance under CAI or a superiority that did not reach statistical significance. Their conclusion was that CAI, carefully developed and properly used, could provide effective educational results.

Rosamentier, Alfred S., Remedial Mathematics Skills Program, Educational Resources Information Center, ED 137 478, New York City Board of Education, Brooklyn, New York, 1975, 21 pp.

This study reported on a remedial mathematics skills one year program in 50 New York high schools. Their objective was to improve students' computational skills through the use of calculators and computer assisted drill work in an individualized program. Definite gains were acheived by students as measured by the Metropolitan Acheivement Test. For example, in ninth grade the mean pre-test score predicted a mean post-test score of 6.31. The actual mean post-test score was 7.21 which differed significantly from what had been predicted. It was concluded that the teaching of computational skills to high schools students with the aid of calculators and computer assisted drill was effective in significantly improving mathematics skills.

Thomas, David B., "The Effectiveness of CAI in Secondary Schools," AEDS Journal, 12:103-116, Spring, 1979.

This article reviewed studies of achievement, attitude, retention and time savings of CAI. It was concluded that students exposed to supplementary instruction through CAI performed at a higher level than students who did not have such exposure. It was also concluded that the evidence of no difference between CAI-taught and traditionally-taught students predominated when CAI was used as a replacement for classroom instruction. The studies agreed that CAI exposed students had the same or more favorable attitudes toward their instructional situation and often toward the subject. Retention levels were found to be comparable for both methods. And it was clear from the studies that CAI study reduced the time required for a student to complete a unit.

Effects on Attitudes

Beck, John J. Jr., "The Effects on Attitude of Anticipated CAI in Selected Courses of Study," AEDS Journal, 12:138-145, Spring, 1979.

Research was done in two high schools on students' attitudes toward anticipated CAI usage in courses of study. The research showed that students enrolled in computer science courses adopted a significantly positive attitude toward the anticipated use of CAI in their course. Students in other courses courses did not show a significantly positive attitude toward the anticipated CAI usage, although the attitude toward anticipated CAI usage in mathematics courses was more positive than that demonstrated in other disciplines. The researcher gave his opinion that the name of the course may have caused students to adopt a more positive attitude in the computer science course and/or those students may have expected this learning style and their attitudes reflected their expectations.

King, Anne Truscott, Impact of Computer-Based Instruction on Attitudes of Students and Instructors, Educational Resources Information Center, ED 112 872, Air Force Human Resources Laboratory, Brooks AFB- Texas, May,1975, 33 pp.

This author conducted a review of investigations to explore attitudes of teachers and students toward various models of CBI. Most studies found that both high and low acheivers had favorable attitudes. Students who chose their own computer work had higher attitude scores. Instant feedback influenced students to be more accurate, which both students and teachers liked, The 'active quality' was seen as a plus by both instructors and students and students seemed to be more favorable after actual contact with the computer. Some of the negative aspects seen by instructors and students were the malfunctioning of equipment, scheduling problems and the lack of alternative correct responses. It was found that students tended to have initially positive attitudes while teachers had less favorable attitudes until they discovered the savings in administrative time and work they afforded.

Effects on Special Populations

Chiang, Alice and others, Demonstration of the Use of CAI with Handicappad Children, Educational Resources Information Center, ED 166 913, RMC Research Corporation, Arlington, Virginia, September, 1978, 82 pp.

This study gave the findings when CAI was employed in teaching approximately 200 mentally handicapped students. Pre and post-tests were administered to all students in both the control and treatment groups. In three-fourths of the cases, treatment group gains were positive and significant at the 80% level in over half the cases. The researchers believed that the gains were remarkable given that students spent an average of only 30 minutes per week taking CAI lessons. Questionnaires administered at the end of the demonstration year found that 85% of the students liked it and felt that the computer lessons helped them. Eighty-three percent of the teachers were very satisfied and 87% of them saw CAI as a very useful and promising method of supplementary instruction.

Fricke, James E., Computer Assisted Instruction in a School for the Deaf, Educational Resources Information Center, ED 129 270, Scranton State School for the Deaf, Scranton, Pennsylvania, August, 1976, 6 pp.

This was a report of the results when the CCC (Computer Curriculum Corporation) CAI drill and practice programs in mathematics, science and language arts were employed in a school for the deaf. The number one benefit reported was the improvement in acheivment. Middle school gains in mathematics averaged 1.3 grade levels during the year, 1.1 for high schools. (This in a school where the yearly acheivement gains were usually below one grade level.) A second benefit they experienced was the 'awakening' of dormant students. Some students who had not seemed to be interested in or have abilities in other classes seemed to be motivated by the CAI. It was concluded that CAI could play an important part in the education of the deaf.

Maser, Arthur L. and others, Highline Public Schools CAI Project, Educational Resources Information Center, ED 167 114, Highline Public Schools, Seattle, Washington, June 30, 1977, 114 pp.

This paper published the results of a CAI project providing an alternative approach to individualizing instruction in basic skills for economically and educationally disadvantaged students. The mean grade equivalent score gain on the SAT mathematics section was 1.15 months per actual month and 1.46 months on the CCC author's procedure. Questionnaires distributed at the end of a year's program found that students had a positive attitude toward work on CAI terminals. (Mean response of 3.99 on a 5-point scale.) They reported liking to work on the computer, found it easier for them to learn, liked the math lessons best and found the difficulty just about right. Parents acceptance of CAI slightly exceeded that of most students. (4.07 mean) The faculty gave CAI the highest rating. (4.22 mean) They and the parents felt that it contained the basic skills necessary for the students.

The Special Aspects of Micrcomputers

Perceived Advantages and Disadvantages

Bell, Fred, "Classroom Computers: Beyond the 3 R's," Creative Computing, 5:68-70, September, 1979.

Bell stated that it may be that the personal computer will find its mark in the home first and then on to the schools like many other innovations (e.g. TVs and calculators). He maintained that personal computers in the hands of students can remove some of the artificial constraints of typical classroom environments and replace them with some of the personal freedoms inherent in many non-school settings. He also stated that personal computers can bring high-level, self-motivated learning into the hands of the teachers and students. And because of their low cost, easy accessibility and person-on-the-street popularity, Bell stated that they may provide the long awaited catalyst that is needed to make some dramatic changes in how computers are used in schools.

Clark, Robert C., "Applications for Microcomputers in Pre-College Mathematics," The Computing Teacher, 8(4): 33-37, Academic Year, 1980-81.

According to Clark, the microcomputer can be very effective in the classrrom in four areas; CAI, drill, simulations and as an object of study. The author quoted a study which showed that the microcomputer as a tutor had some flaws. Although using the micrcomputer was easier and allowed more free time for the teacher, for students the diagnosis was poor and interaction was low. The micrcomputer, according to this author, had good applications for drill although the cost factor was seen as a problem if this was to be its only use. He maintained that simulations offered the greatest potential since this was an area difficult to deal with in other means. Courses in computer literacy, programming and problem solving had many far reaching, positive outcomes according to Clark but adding computer programming to the curriculum sould present problems in teacher training, student selection and adjustment of the curriculum.

Elliott, Bob, "Programming in the Classroom," Mathematics in School, 8:11, March, 1979.

This teacher gave his school's reasons for changing from a full line computer system to a microcomputer system. Two of the aspects of the microcomputers that appealed to his staff were the immediate feedback and the fact that their lower costs would enable the school to purchase more machines and so give that many more students the opportunity to be 'hands-on'. The teachers were also excited about being able to demonstrate and edit with the students as they worked at the microcomputer. Elliott and other staff members believed that the microcomputer could help eliminate the awe and the 'big brother' concept experienced by many with the full line system.

Price, Camille C., "Microcomputers in the Classroom," Mathematics Teacher, 71:425-427, May, 1978.

Price hailed the microcomputer as the answer to the need for computers in the classroom despite their enormous costs. She noted that their smaller size and lower costs would allow more students access to the machines and the close association with a microcomputer would allow students to learn the design and basic principles of computer organization. Microcomputers purchased in kit form may provide other bonuses, according to this author-- a project that can be undertaken by vocational and mathematics classes jointly, a project that can be interesting to different students and the school could acquire several working systems over the years for an even lower cost.

Effects of Microcomputer Programs

Bjorum, William, "Introducing Micrcomputers to Instructional Education," The Computing Teacher, 8(5):39-40, Academic Year, 1980-81.

Bjorum described the use computers and increasingly, microcomputers, in his schools district. He described their uses of the micrcomputers for studying computer science as well as for CAI. They found the use of microcomputers to be very appealing to the students and some of them became very proficient and made remarkable progress in programming, according to this author. He identified problems in several areas. There were not enough computers to satisfy their needs. And they found the need to shift the emphasis from computer games and CAI to computer science. But they did find that the increased availablity and lower costs of microcomputers helped to alleviate some of these problems.

Kleiman, Glenn and others, "Microcomputers and Hyperactive Children," Creative Computing, 7:93-94, March, 1981.

This article reported on research conducted at the Child Development Clinic, Hospital for Sick Children. The resaarch compared hyperactive six to fourteen year old's performances on arithmetic problems administered by computers with problems given in standard format. The researchers found no difference in the percentage of problems correct or the average time to do the problems. The difference occured in the number of problems the children chose to do. (They were asked "to do as many problems as you want and stop when you have done enough.") On the average, 31.4 problems taking 23.3 minutes were done per child on the computer compared to 17.6 taking 12.6 minutes with paper and pencil. Interviews with the children confirmed their preference for doing drill work on the computer. They found it motivating and liked the immediate feedback. The teachers liked the fact that it could be tailored to each child's needs.

Spero, Samuel W. Dr., "The TRS-80 as a Classroom Teaching Tool," Calculators/Computers Magazine, 2:58-59, November/December, 1978.

Spero cited their experiences when his school system installed and began using a TRS-80 micrcomputer. The first thing that appealed to the staff was its portability. The system was portable enough to be moved from room to room and from school to home. And some of the teachers were willing to work at home on developing software. This school system did not encourage CAI since they believed that it would not be cost-effective or pedagogically effective to dedicate the facility to just one student. Students did use the microcomputer to help them with problem solving algorithms in the mathematics classes and a class in computer programming for gifted students was started in the junior/senior high school. Spero reported a real return from his school's investment in terms of student's awareness of the possibilities and limitations of the computer and the interest and effort displayed.

SUMMARY

Research indicated that the use of computers in the classroom had risen over the last ten years. Most noticeable was the rise in the use of the computer for instructional purposes such as computer science courses and computer-assisted instruction. The most applications of the computer were found in the mathematics department. It was stated though, that computers have not effected the curriculum as they might have. Reasons given for the relative reluctant change of the mathematics classroom included an ignorance, and a '1984 syndrome' surrounding these machines. And yet, both the NCTM and the NACOME recommended that computers be integrated into the total school curriculum.

The teaching of computer literacy was seen to be an effective means of introducing the computer to all students at the secondary level which was given as a necessity to adequately prepare students to function in their future world. Good computer literacy courses included some basic programming and some research into the hows and whys of a computers design. Results from programs showed that the computer served as a motivator and as a means of awakening student's drive and creativity.

The teaching of computer science was seen to be of value in reinforcing student's logical thinking and problem solving abilities. Also mentioned was the need for high school

computer science courses to provide a background for further study into the wide range of applications made possible by computers. Results from programs showed that the study of computer science had positive effects on student's understanding of mathematical concepts and thought processing techniques. The offering of computer science courses was seen as a means of helping computers to 'get their foot in the door'-- sparking interest in using computers for other purposes. The lack of adequately educated teachers was cited as a major drawback in offering these courses along with the addition of a new course to usually already overcrowded curriculums. Also given was the problem of devoting the facilities to a small, elite group of students.

The use of the computer for computer-assisted instruction was seen to be of value in individualizing instruction, tutoring and performing drill work, especially in remedial mathematics. Results from supplementary CAI programs showed significant increases in acheivement. Effects on retention levels were negligible, but compressed learning time was cited. Significantly positive attitudes on the part of involved students and teachers were attributed to the immediate feedback and the creative, hands-on qualities. CAI also showed good results in acheivement and attitudes in the three studies presented of the deaf, handicapped and econmically disadvantaged students. Several drawbacks were cited in using the computer for CAI.

Among them was again, a lack of qualified educators to adapt the available software and implement the creative use of the computer in individual classrooms. Another drawback was the lack of good software. And the cost factor of a computer system was seen as prohibitive if the facility was to be devoted to one student at a time as it usually was in CAI programs.

Microcomputers were seen to have many advantages over the fuller size models including lower costs, (even lower if purchased in kit form), smaller size, portability and a less 'awe-inspiring' appearance. Results from programs showed that microcomputers performed the same tasks with much the same results as larger models. They were also seen to spark interest and motivate students.

CONCLUSIONS

It was generally concluded that all students should be exposed to the computer as an educational tool. Although some educators advocated the teaching of computer literacy or computer science or using the computer for CAI in mathematics classrooms, NACOME and Clark advocated the integrating of the computer into the total school curriculum.

Specifically, it was concluded by Bruchmann, Dunlap and Knight that some sort of computer literacy experience was needed to better prepare students for living in a technological society. It was determined by Saunders and Bell that the study of computer science could bring positive results in developing good thinking patterns and reinfrocing mathematical skills.

It was also concluded that computer-assisted instruction could be a useful supplementary aid. According to Dunn and Joiner, it could be of value in teaching remedial mathematics, individualizing instruction and tutoring in basic skills. It was also concluded in research done by Posamentier, Thomas and Chiang that CAI had positive results on acheivement and attitude.

But it was also concluded that the computer in the classroom had several problems associated with it. According to Kahn and Joiner, there was a lack of quality software and of qualified educators to implement the use of computers in

the classroom.

It was concluded by Elliott and Price that microcomputers could solve the problems with cost and accompanying lack of equipment in the schools.

RECOMMENDATIONS

It is recommended that:

1). All students receive some computer literacy training at the secondary level. That these courses include some exposure to computer programming, some reading and some discussion of the capabilities and limitations of computers.

2). All teachers take advantage of any computer training offered as part of any inservice program. And that all mathematics teachers (and mathematics education majors) elect to take computer courses as part of their undergraduate and graduate studies.

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